

REMARKS

The Office rejected the originally presented claims as obvious over Taguwa (US 2003/0170942) in combination with Lim (US 2005/0009281). The Office asserts that Taguwa teaches a method that includes (i) forming a first layer which is mainly made of a material other than tungsten, (ii) forming a second layer mainly from tungsten and (iii) forming an oxide film on an exposed surface of the first non-tungsten layer (see the first paragraph on page 3 of the October 22, 2008 Office Action). The Office acknowledges that Taguwa does not teach a process that includes forming an oxide layer by plasma processing using a process gas containing O₂ and H₂ at a hydrogen gas to oxygen gas flow rate ratio of 2-4.

The Office asserts that Lim discloses a process in which an oxide layer is formed carrying out plasma processing with a gaseous mixture containing O₂ and H₂. The Office asserts that one of ordinary skill in the art would use the oxide-forming step of Lim in the process of Taguwa to arrive at the presently claimed invention.

Applicants submit that the rejection is unsupportable for several reasons. First, the Taguwa process would be rendered inoperable if modified in the manner according to Lim. Taguwa discloses a heat treatment that forms an oxide layer by carrying out processing with a gaseous mixture including H₂, steam and nitrogen gas (see paragraph [0040] of Taguwa). Importantly, the heat treatment used to form an oxide layer in Taguwa causes an additional, different oxidation. For example, the oxidation also forms a tungsten nitride silicide (WSiN) film (see paragraph [0040] of Taguwa) and/or a tungsten nitride (WN) film. Taguwa discloses the following with respect to the properties of the resulting oxidized device:

The thermal oxidation also forms a tungsten nitride silicide (WSiN) film 15 having a thickness of 5 nm or less between the WSi₂ film 14 and the tungsten nitride film 16. It is to be noted a thickness above 5 nm for the tungsten nitride silicide film 15 increases the electric resistance of the WSiN film 15 to increase

the interface resistance between the tungsten nitride film 16 and the DOPOS film 13.

See paragraph [0040] of Taguwa. The nitride-containing film of Taguwa is therefore an essential part of the Taguwa process. A modification of the Taguwa process which avoids formation of nitride layers cannot for the device of the Taguwa publication.

In contrast, Lim discloses an oxygen plasma treatment carried out with a mixture of H₂ and O₂ gas. The process of Lim does not include carrying out a plasma process with a gas mixture comprising either of steam or nitrogen. Applicants submit that those of ordinary skill in the art would not be motivated to replace the oxidation step of Taguwa with the oxidation step of Lim for the reason that the resulting process would not form the nitride-type layers formed in the Taguwa process, e.g., the modified process would be inoperable. As noted above, the Lim process uses a gaseous mixture containing O₂ and H₂. Such a gaseous mixture is incapable of forming the nitride materials formed in the Taguwa process. Of course, Taguwa can form such nitrides species because the Taguwa process uses a mixture that includes steam and nitrogen.

Applicants thus submit that those of ordinary skill in the art would not modify the Taguwa process by inclusion of the Lim process for the reason that the resulting microelectronic device would have substantially different chemical composition and structure (e.g., the resulting device would have no nitride layer formed during the oxidation step). The combination of Taguwa and Lim is thus not supportable and the rejection should be withdrawn.

Second, Applicants submit that the Office's assertion that it would be obvious to optimize flow rate ratios of Lim is contrary to the Lim disclosure. The present claims recite a plasma treatment that uses a gas flow rate ratio of hydrogen/oxygen gas of 2-4 (e.g., an oxygen/hydrogen ratio of 0.25-0.5). Lim discloses an oxygen/hydrogen flow rate ratio of

0.01-0.2 (i.e., a hydrogen/oxygen gas flow rate of 5-10). There is no disclosure or suggestion in Lim that a hydrogen/oxygen flow rate ratio outside that disclosed in the Lim publication may function as an oxygen plasma treatment. Lim discloses the following:

In order to use oxygen and hydrogen as the plasma source together, the flow ratio of oxygen/hydrogen is set to 0.01-0.2.

See paragraph [0015] of Lim.

Lim therefore sets definitive threshold levels for the oxygen/hydrogen ratio. Lim does not suggest that any other oxygen/hydrogen ratio outside the 0.01-0.2 range may be used.

Applicants thus submit that “optimization” of the Lim hydrogen/oxygen flow rate ratio provides flow rate ratios only within the range of 5-10. There is no disclosure or evidence of record that one of skill in the art would look outside this ratio to “optimize” the Lim process.

Applicants thus submit that the Office’s assertion that it would be obvious to optimize the Lim hydrogen/oxygen ratio is legally not supportable and the rejection should be withdrawn.

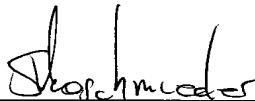
Third, Applicants submit that Lim teaches away from the presently claimed invention. For example, Lim in paragraph [0005] describes a background or related art process that is carried out in an H₂ rich oxidation atmosphere. Applicants submit that this disclosure teaches those of skill in the art that optimization may occur in an H₂ rich zone but not by starving the Lim process of hydrogen, e.g., Lim teaches away from plasma treatment at a hydrogen/oxygen gas flow rate ratio of 2-4. Applicants further submit that one of ordinary skill in the art would have no encouragement and in fact be deterred from using lower ratios of oxygen/hydrogen (e.g., in a hydrogen poor amount) in view of Lim’s disclosure that hydrogen rich oxidation atmospheres are preferred.

For the reasons discussed above in detail, Applicants submit that the Office's combination of Taguwa and Lim is legally not supportable for the reasons that (i) the Lim plasma oxidation step is not interchangeable with the Taguwa heat treatment oxidation step, (ii) Lim discloses a threshold range that is outside the oxygen/hydrogen gas flow rate range and thus optimization of the Lim flow rate ratio range cannot lead to the presently claimed invention; and (iii) Lim teaches away from the assertedly obvious modification by disclosing that H₂ rich environments are preferred whereas the presently claimed invention recites an oxygen/hydrogen gas flow rate ratio range that is lower than that disclosed in Lim.

Applicants request withdrawal of the rejections and the allowance of all now-pending claims.

Respectfully submitted,

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